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Abstract

Despite improved food security, China faces multiple complex and intersecting challenges to its food and agricultural systems, related not only to socio-economic and environmental changes, but also to political reforms that have come with the opening of the economy over the past 30 years. In this context, we argue that social complexities, particularly around the role of the public sphere in policymaking, have been underplayed in studies of China's agri-food transitions (with quantitative surveys by far the most prominent approach adopted within China thus far). A deeper understanding is required of the role of public perceptions of agricultural innovation, particularly around the controversial potential commercialization of genetically modified crops. Evidence from a three-year project drawing on multi-method qualitative field research suggests that earlier work failed to take account of the complex role of public perceptions (elsewhere referred to as 'market/ user preferences' or 'culture') in agri-food transitions. This raises important questions for the governance of Chinese agri-food transitions and how future research might better inform its response to a changing public sphere.

Keywords: GM foods; Public opinion; Food safety; Regulation; Sustainability; Innovation

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Abstract

Despite improved food security, China faces multiple complex and intersecting challenges to its food and agricultural systems, related not only to socio-economic and environmental changes, but also to political reforms that have come with the opening of the economy over the past 30 years. In this context, we argue that social complexities, particularly around the role of the public sphere in policymaking and practice, have been underplayed in studies of China's agri-food transitions (with quantitative surveys by far the most prominent approach adopted within China thus far). We argue that a deeper understanding of public perceptions of – and engagement with - agricultural innovation, is required. In order to demonstrate the kinds of additional evidence that might contribute to an enhanced understanding of the role of the public sphere in China's agri-food transitions, we present findings from an exploratory project drawing on qualitative field research. Focussing in particular on public perceptions of genetically-modified crops, we suggest a number of preliminary insights that confirm, challenge or supplement earlier findings. We use this study, in the particular socio-political context of China, to shed light on the complex role of public perceptions (elsewhere in the transitions literature referred to as 'market/ user preferences' or 'culture') in agri-food transitions. This raises important questions for the governance of Chinese agri-food transitions and how future research might better inform its response to a changing public sphere.

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1. Introduction

1.1. Challenges in China's agri-food transitions

Since China's Reform Era began in the late 1970s, the agri-food system underwent a series of transitions, including around land tenure, trade, investment and technology. Despite neo-Malthusian forecasts (Brown 1994), food security in China over the past 20 years has largely followed more optimistic predictions (Paarlberg 1997), with increased production leading in turn to pressures on water and land (Ghose 2014). In 2017, China's first policy document of the year, the so-called "No.1 Document", focused for the 14th year on food and agriculture, underscoring its centrality as a policy agenda for the government (Xinhua 2017).

The last decade saw a renewed emphasis on top-down, supply-side innovation and the role of science and technology policy in supporting agricultural biotechnology and genetically-modified (GM) food, as part of a transition that included wider systemic adoption of more intensive production approaches, longer and more complex supply chains andmore a concentrated ('supermarketised') retail sector. In analysing these changes, Ely et al (2016) have characterised this as the 'indigenous innovation' pathway, framed by top-down planning, or 'systemic rationalities' (Spaargaren et al 2012), which at once respond to both the country's industrial development and food security objectives. While transitions concepts such as the multi-level perspective (Geels 2002) have not been used to analyse the changes underway in China's agri-food system, the extent of the transitions that have already been brought about by such systemic changes can be evidenced by increases in production (Ghose 2014), productivity (Wang et al

2013), average calorie consumption (Carter 2011), reforms in supply chains and retail (Hu et al 2004) and a dramatic increase in protein-rich diets (Schneider and Sharma 2014).

Partly due to this ongoing reconfiguration of China's agri-food systems, the country faces multiple new, complex and intersecting challenges to its food and agriculture systems – in particular, environmental and food safety problems (Holdaway 2015). For many consumers, the food contamination, health quality and safety effects of this unsustainability are at the forefront of the country's new challenges: Yan (2012, 706) argues that Chinese society has been "affected more by food-safety scares than has any other on earth" and notes that in official surveys, "the Chinese public consistently considers food safety a top concern". The role of these consumers in the "public sphere" (Habermas 1962) is, however, a relatively neglected area of study in China's agri-food transitions.

In this article, we consider the role of the public in China's ongoing agri-food transitions, focussing on the importance of politics and practices in socio-technical systemic change (Tyfield et al 2015). We argue that in China's particular social and political context, the perspectives of consumers regarding food and agriculture, understood as 'lifeworld rationalities' (Spaargaren et al 2012; Ely et al 2016) are key elements of the transitions underway. Drawing on concepts from China studies, we suggest that they are best understood with reference to the 'green public sphere' (Calhoun and Yang 2007). This can be described as a relatively pluralistic civic space that saw the emergence and proliferation of environmental discourses, just as media in China became more diverse and pluralised (Akhavan-Majid 2004) and new communications technologies, facilitated by the Internet, began to transform many public debates (Yang 2009). The 'green

public sphere' provides a template for understanding the changing role of the public in China's transforming agri-food system. Finally, we suggest that applying such a concept to China's particular socio-political context offers insights which may help us reflect upon the ways in which the public have been portrayed in the previously Western-focused transitions literature.

We begin by providing a background to the 'indigenous innovation' pathway to agricultural modernisation in China, including the development, deployment and regulation of GM crops as part of a wider socio-technical transition. We then consider how public perceptions have been addressed in the transitions and wider social sciences literature to date. We first provide a brief overview of the ways in which public perceptions have featured in the literature focussing on historical and contemporary transitions (Section 2.1). We then focus in on the literature on GM crops and agri-food transitions in Europe (Section 2.2), and then (Section 2.3) by reviewing previous studies in the international literature that have investigated public perceptions in China.

We highlight some of the limitations of this literature and in Section 3 point to the green public sphere as a lens through which a deeper appreciation of the public's role might become apparent. This calls for different social science approaches, which can provide a contextual understandings that supplement current (primarily quantitative) data collected in the Chinese context. In order to demonstrate the kinds of insights that these approaches might yield, we present a small empirical study in Section 4 that offers tentative insights into the complex nature of Chinese public perceptions towards GM crops and food. We discuss these in relation to the green public sphere and the ways in which the role of the public has been discussed previously in the transitions

literature. Finally in Section 5, we go on to discuss the wider implications of this analysis for transitions theory and, in particular, for China's agri-food transition.

1.2. GM food and crops in China – changing policies and perceptions

China's Medium-Long Term Plan for Science and Technology (2006-2020) calls for greater 'indigenous innovation': proprietary technologies in which innovation is led by, and intellectual property is held by, Chinese firms. In the agriculture field, transgenic crops are seen as an opportunity for such innovation, building on decades of research and development and supportive agri-tech policies (Ely et al 2016).

In 1993, the State Science and Technology Commission published China's first regulations on the use of recombinant DNA technology. In 1996, the Ministry of Agriculture issued the first regulations on the biosafety of GM crops (Karplus and Deng 2008) and in 2002, the first requirements for GM labelling. In 2015, these were strengthened in Article 51 of the *Seed Law* and article 69 of the revised *Food Safety Law*. China is now the largest importer of GM products in the world (primarily for animal feed), and GM Bt (*Bacillus thuringiensis*) cotton has been grown widely (Van Zwanenberg et al 2011a). However, GM food crops, with the exception of GM papaya grown at a very small scale, have not been approved for commercial planting in China.

The regulatory appraisals of two domestically developed GM crops for food and feed – Bt63 rice and phytase maize – have progressed further than any others, but have presented the country's

regulators with challenges (Ely et al 2016). The discovery of Bt63 rice in food products in Hong Kong and mainland China, and even in exports to Europe (European Commission 2008), prompted regulatory concerns. The government responded with dedicated regulations in 2007 which tried to stem the cultivation of the crop. Regulatory stringency was tightened in Hubei Province, in particular, where the crop had been engineered by Huazhong Agricultural University. More recently, an unapproved US variety of Bt maize was found in the country's seed supplies. In March 2016, Han Changfu, the Minister of Agriculture, acknowledged that transgenic maize had been grown illegally in China (Reuters 2016).

In his first officially publicised remarks on biotechnology, President Xi Jinping said in December 2013 that China should "be bold in research, but cautious in commercialization", with commercialization strictly following "the technical procedures provided by Chinese regulations; the industrialization and commercialization of genetically modified crops shall be steady and make sure no problem occurs, and all safety-related factors shall be considered" (GAIN Report 2015). In 2015, the country's "No.1 Central Document" pledged to, in the words of state newspaper *Global Times*, spread "knowledge about GMOs so that the public can have a clear and comprehensive understanding of this technology" (Chen 2015). Approaches to labelling have also been strengthened. The government announced in 2014 that it was illegal for companies to use words like "healthier" or "safer" with respect to non-GM foods, or to label conventional foods as "GMO-free" when GM versions do not exist (China Daily 2014b). China's 13th Five Year Plan (for 2016 to 2020) emphasizes guaranteeing the "safety and quality of agricultural products."

The government is keenly aware of the influence that regulatory failings might have on the public's perceptions of the technology and the context within which it is being introduced. Some analysts blamed public perceptions (Science 2014) for the failure to renew time-limited licenses on field trials for Bt rice and phytase maize in August 2014. The public may therefore have played a role in the country's agri-food transitions, but few studies have addressed this phenomenon in the international literature. In the next section, we provide a brief overview to some of the social science literature as it has engaged with public perceptions around transgenic food and crops in Europe. We point to specific concepts worthy of attention in the Chinese context, which will be further investigated later in the paper.

2. New technologies, public perceptions and their role in agri-food transitions

2.1 Public perceptions in studies of socio-technical transitions

Transitions studies emerged from an appreciation of the complexity of systemic change and the appreciation of multiple interactions between new technologies and societal changes (Elzen et al 2004) to create new 'socio-technical regimes (Geels 2002). Publics play important roles in system change - both through their direct agency and through their influence on governance – and as such an interest in their 'perceptions' directly follows a recognition of regimes as possessing "social, economic, cultural and cognitive attributes" (Smith et al 2005); public perceptions, understandings or framings (Ely et al 2009) relate to these cultural and cognitive attributes and are thus important to appreciate in studies of socio-technical regimes and transitions.

It is not possible to fully review the multitude of ways in which 'public perceptions' have been framed within this burgeoning literature, however it is possible to point to various strands of work that have incorporated perceptions into what might be called a transitions perspective. Historical studies have detailed how shifting norms and expectations have accompanied broad socio-technical change. The multi-level perspective on socio-technical transitions, for example, includes references to 'culture, symbolic meaning' and 'markets, user preferences' as constituting dimensions of regimes and these shifts have been investigated in numerous historical case studies around shipping (Geels 2002) cargo handling (Van Driel and Schot 2005) or rock'n'roll (Geels 2007). Such historical studies have not allowed empirical investigation (beyond the use of secondary data or texts) of changing perceptions but have linked these to the shifting norms, expectations and practices that have accompanied broad systemic change.

Work describing the role of pioneer activists in developing and growing sustainable green niches (Smith 2007) has detailed activist perspectives around organic farming or eco-housing, but again on the basis of historical cases (without contemporary empirical study). More contemporary work on grassroots innovation (Smith et al 2016; Smith and Ely 2015) have rarely looked at perceptions *per se* although there has been work on motivations of grassroots innovators (Bhaduri and Kumar 2011) and expectations in community energy (Seyfang et al 2014). In other studies of contemporary transitions, researchers have been able to combine more schematic descriptions of socio-technical change with empirical data on changing public perceptions. The active role of technology users in energy transitions, for example, has looked at shifting practices

and their meanings among users/consumers (Shove and Walker 2010) and more recently 'prosumers' (Hansen and Hauge 2017).

The role of publics in agri-food transitions has also been highlighted in some of the above studies (Smith 2007), as well as in other work detailed below. In comparison to other sectors, however, comparatively less attention has been paid to the introduction of novel technologies (such as products of modern biotechnology) or the way that they are perceived by users or the public in these studies, and more has been paid to changing practices as a central driver of system change (Spaargaren et al 2012; Cohen & Ilieva 2015). This can be compared with transport, for example, in which studies have looked at public perceptions of electric vehicles (for example Tyfield and Zuev in this special issue), or of public opinion on policies around public transport (Upham et al 2015). This latter study rightly points out that transitions management "has paid relatively little attention to public consultation on socio-technical change" and describes how public opinion surveys "alongside qualitative, discursive forms of engagement" can be used to inform transition management. Within liberal Western democracies such as Finland (where Upham et al base their work), such participatory democratic inputs to transition management are unproblematic and normatively valued. This paper queries whether similar approaches might play a role in understanding and governing transitions in China.

2.2 Public perceptions of agricultural biotechnology in European food transitions

Whilst perceptions around the introduction of transgenic crops have not been analysed through 'transitions' lenses, the broader social science literature, provides us with a wealth of resources

with which to understand the role that public perceptions play in enabling or constraining socio-technical system changes. Here, we review some of the literature in Europe, to highlight concepts such as the 'deficit model' the analysis of 'framings' and 'trust' in risk and regulation.

Some of the early European literature in the 1980s and 1990s (Royal Society 1985; Sturgis and Allum 2004) proposed that increased information and improved levels of technical understanding will lead to greater public acceptance of a novel technology. Described as the "deficit model of the public understanding of science", this diagnosed education (for increased technical understanding) as an appropriate response to a sceptical public. In response to this "deficit model", social scientists embarked on efforts to capture more detailed evidence on public perspectives (beyond technical understanding), either through standard social science techniques such as surveys (Gaskell et al 2010) or through deliberative, inclusionary processes (Wakeford 2001). At the height of its controversy in the late 1990s and early 2000s, the GM area in Europe represented a fertile ground for these kinds of studies.

Focus group studies investigating public attitudes to GM crop commercialisation in Europe (Marris 2001, Marris *et al* 2001) suggested that scepticism of agricultural biotechnology was not linked to objective knowledge that could be increased through scientific education. Rather, surveys (INRA (Europe)-ECOSA 2000) showed that "those with the highest level of education are more assertive in their opinion", either for or against the technology (Eurobarometer 1999). This so-called "narrow-but-deep" component of the UK's *GM Nation?* public debate found that "when people in the general population become more engaged in GM issues, and choose to discover more about them, they harden their attitudes to GM. Although they are more willing to

accept some potential benefits from GM (especially medical benefits and other advantages for developing countries) they become more doubtful about the others and they express more concern or greater unease about risks associated with GM (DTI 2003). More recent literature from Europe has thus discussed a shift from the "deficit model" to one focussed on "public engagement in science and technology" (Bell et al 2008) or a move from "deficit to dialogue" (Stilgoe et al 2014). Millstone's (2009) co-evolutionary model of decision-making and the general framework of the International Risk Governance Council (2005) provides different views on when and how public and stakeholder engagement can contribute to policy making, in particular in controversial areas of food policy.

The Chinese context for food and agricultural policy is strikingly different to that in Europe 20 years ago, and its different socio-political environment makes it unwise to extrapolate Western arguments about what constitutes appropriate governance (see Ely 2015). However, we believe that particular research and policy experiences from Europe can be informative and might help in understanding the dynamics outlined in our results in Section 4.

Other studies in the risk and regulation field have emphasized the importance of forms of knowledge and understanding other than scientific-technical, in making both personal and policy judgements, and highlighted the validity and value of lay knowledges in guiding decision-making, especially under uncertainty (e.g. Wynne 1992, 2004; Stirling 1999). Attention beyond a focus on biophysical risks to the wider social context in which GM crops were being introduced illuminated different "framings" of (regulatory or other) decisions related to these new biotechnologies. The idea of framing, as applied to food safety governance, has been

defined as "the ways in which individuals' or social groups' world views, or the conditions under which they operate, can influence the production and/or interpretation of data or knowledge" (Ely et al 2009).

The European (and to some extent US) literature has shown how issues such as experience of regulatory success and failure, and resulting changes in public trust of institutions, can have a bearing on the ways in which the risks of new technologies are "framed". Trust in regulatory institutions has long been identified as an important factor in risk governance (Slovic 1993), in particular to food risks (Frewer et al 1996), in which the interplay between regulatory failures media reporting have been highlighted as potential explanations for European publics' rejection of GM food. Lofstedt's (2005) work has applied surveys in an attempt to understand how the public's trust in government regulation declined in the West through the 1990s and described approaches to risk management most appropriate to "post-trust" societies. It has also pointed towards to the possibility of paternalistic approaches to governance in countries with higher levels of trust (such as Sweden). In Europe, scholars have investigated the widespread impact on public trust as a result of scandals such as the BSE crisis (Wales et al 2006).

Despite a few notable exceptions (Yan 2012; Yang 2013; Zhang and Oosterveer 2014, discussed further below), similar concepts or the qualitative research methods that might be used to explore them have rarely been applied in studies of GM technology or agri-food transitions in China. Most Chinese scholarship has adopted quantitative approaches that provide useful insights into consumer opinion, but largely fail to enable the in-depth interrogation of the role of public perceptions in agri-food transitions.

2.3 Literature on perceptions of GM crops in China

Responding to early policy concerns that low public acceptance might affect the adoption of agricultural biotechnology, studies investigated how the Chinese public perceive GM foods. Most showed greater support for the technology than early European studies. For example, Li *et al* (2002) studied consumer attitudes in Beijing, finding most surveyed consumers had little or no knowledge of biotechnology. Using an econometric model that judged respondents' willingness to pay for GM or non-GM products, it concluded that respondents generally had "a favorable view towards GM rice and GM soybean oil". Lü (2006) studied public understanding of biotechnology in Zhejiang, eastern China, and concluded most respondents believed "applications of biotechnology… would be useful for society". Huang (2006) published the first large survey of Chinese urban consumers across eastern China, finding more than two thirds had "heard of" GM foods, that their "acceptance of and willingness to buy GM foods was much higher than in other countries", and concluding that "the commercialization of GM foods is not likely to receive great resistance from the consumers in China".

Some of these studies attempted to study the sources of information that shaped consumer attitudes and thus the reception of GMOs in China. One study of two official, national newspapers, the *People's Daily* and *Guangming Daily*, from 2002 to 2011, concluded that Chinese reporting of GM crops had emphasized the benefits of transgenic organisms and that no articles had portrayed GM crops in a negative light (Du and Rachul 2012). Liu and Cong (2014)

also studied a range of Chinese newspapers and found some negative reports, but concluded that most continued to represent GM crops in a positive light.

Han *et al* (2015) looked not only at the attitudes of consumers, Bt cotton farmers and scientists in China, but also the "factors influencing their attitudes". Alongside positive attitudes amongst scientists, their study found that farmers had a "very positive attitude because Bt cotton provided them with significant economic benefits". Among consumers, Han *et al* (Ibid.) found something more complex. They examined results from a survey conducted from 2007 to 2008, and another in 2010, which provided consumers with the options: "support", "follow the recommendations of the government", "undecided", or "do not support" GM foods. The framing of this study conflated all the first three groups and removed the consumers who "do not support" the sale of GM foods, suggesting that 73.8% and 67.5%, respectively, of consumers in each surveys "may be accepting of the sale of GM foods", downplaying the significance of the large "undecided" category (which has been highlighted as a weakness of other studies of public perception – cf. Poortinga and Pidgeon 2003) or the fact some of these groupings might not be mutually exclusive. This raises questions about the relationship between government assurances and public perceptions, which Han *et al*'s study left unexplored.

As for the factors influencing consumers, Han *et al* (Ibid.) found respondents accessing information from multiple media, but the authors put the blame for critical attitudes squarely on "anti-biotech efforts by non-government organizations (NGOs) in China", which influenced "misleading reports and anti-GM information presented in the public media, especially on the internet". Diagnosing a stark "deficit model" response, the paper concluded that: "Further

educational efforts will be critical for influencing consumer attitudes and decisions of government agencies in the future. More effective educational efforts by government agencies and public media concerning the scientific facts and safety of GM foods would enhance the acceptance of GM crops in China."

Similarly, Huang and Peng (2015, 2392), building on Huang *et al* (2006), addressed consumers' changing perceptions of GM food in a context where "information reported in media is often unreliable and misreports the science" and an "anti-GM movement has appeared widely in various domestic media", presenting a likely "major hurdle for China to continue developing and applying GM technology in the future" (Huang and Peng 2015, 2399). They found a rapid increase in respondents perceiving GM foods as "unsafe for consumption" over the period 2010 to 2012 (from 18% to 45% of respondents) and that respondents with higher educational levels were more likely to believe that GM food was unsafe for consumption. Yet despite this finding, Huang and Peng conclude that "more efforts may be required to popularize science and technology in general and GM technology in particular" (*Ibid*, 2399).

Only Jia and Liu (2014), in examining GM controversies in China, concluded that "science communication efforts in the country must be focused on constructive dialogues and public engagement with science" rather than popularization efforts. The authors suggest GM constitutes the first example in recent history of the Chinese public challenging science's previously "ideologically unchallengeable orthodoxy" and note that GM controversies in China arose from the perception that "scientists are not free from corruption" (Jia and Liu 2014, 34). Similarly,

Keeley (2005, 157) suggested that China's "embrace of the biotechnology revolution" was "…not as unequivocal as much global discourse suggests…" among consumers and others. Jia and Liu (2014) found through surveys that scientists in China were disengaged from public-facing work, with the result that "when S&T controversies arise, the science community either evades answering the public's inquiries, or largely talks about the case in jargon with professional arrogance" (*Ibid*, 35).

These are important areas to explore, but are difficult to study using the quantitative approaches favoured in previous studies in China. Rather than simply exploring levels of knowledge or degrees of support, a more qualitative understanding of the interplay between these and perceptions of policy-making (mediated by public debate and various dimensions of trust) is necessary. In the next section we introduce the notion of the 'green public sphere' that has emerged in studies of environmental policy-making in China, and interrogate whether it has anything to offer the current case of GM crops and agri-food transitions. We also point to other concepts from China Studies to explore the role that public opinion plays in decision-making in other sectors.

3. The "green public sphere" and its utility in understanding public perspectives around novel food technologies and their role in agri-food transitions

It is important to study China's agri-food system transitions within their specific social and political contexts. China's political system today has been described variously as "hard authoritarianism" (Shambaugh 2016), "fragmented authoritarianism" (Lieberthal and Oksenberg

1988), “consultative authoritarianism” (Teets 2014) and “consultative Leninism” (Tsang 2009). Regardless of the descriptor one favours, China’s political context permits only restricted, government-managed political space for non-state actors in the governance of agri-food systems.

However, it is also evident the environment is one of the first spheres in which public opinion has been seen to affect policy in China (Sun and Zhao 2008, Zhan 2011), including through NGOs (Ho and Edmonds 2008) and frequent urban protests, typically in response to anticipated pollution around petrochemical, incineration and other proposed developments (Ansfield 2013, CCICED 2013, Geall and Hilton 2014). In 2013, for example, the municipal government’s willingness to consider “public opinion” was a seen to have been decisive in ending a serious of protests against a proposed chemical plant in Kunming, southwest China (Xinhua 2013). Similarly, Chinese state media championed the “satisfying response” to protest from policymakers (Xinhua 2012) that Beijing authorities demonstrated in improving transparency around air pollution (Boyd 2013, 42).

Chinese concerns and attitudes towards health and the environment and their relationship to perceptions of GM foods suggest popular discourses similar to those described as the “green public sphere” (Calhoun and Yang 2007). This notion, which draws from Habermasian (1962) thinking around how individuals contemplate and discuss societal problems and potential responses, was used by Calhoun and Yang to describe the emergence of public debate around environmental issues (e.g. dam-building on the Nu River, in southwest China) through mass media, the internet and “alternative media”, and its links to “grass-roots political change”.

There may therefore be important parallels and overlaps with food and agricultural policy in China that have not been widely noted in the literature on the nascent environmental movement. For example, scholars have noted public discourses related to the environmental and social dimensions of food and agriculture, such as those explored by Yan and Chen (2013), where the future of farming, farmers and the countryside are discussed in terms of a "complex of interrelated problems", combining urban-rural disparity with environmental deterioration, and Day and Schneider (2017, 9), who found that the period 2003-2007 saw widespread "public debate on the future of the peasant and Chinese agriculture" intersecting with the New Rural Reconstruction movement.

In an extension from the original conception, therefore, the "public sphere" of interest to this paper relates to the environmental and social dimensions of food and agriculture. They therefore go beyond a focus merely on the putative biophysical risks associated with GM technologies and instead see these as a component of wider transitions – transitions in which the Chinese bourgeoisie (in Habermas's terms) take an interest in. Evidence of such concerns is expressed through consumer demand for alternative food supplies (cf. Ely, Geall and Song 2015), particularly local and digitally networked offerings in which supply chains can be better monitored through personal connections and consumer trust can be rebuilt in a context where institutional trust has waned (Zhang and Oosterveer 2014).

Despite the recognition of these dynamics in policy-making, most Chinese research (as illustrated above) has implicitly adopted the deficit model by seeking to explain low levels of support for GM technology on the basis of a lack of understanding (rather than an engagement

with wider societal challenges of agriculture) and to provide advice on how Chinese publics' views can be changed to welcome the technology. Similarly, in response to the problem of "controversial views", government approaches so far have tried to use "media, seminars and street advertising to combat the perceived risks" (China Daily 2014a). The above discussion suggests that there are more complex considerations to be borne in mind, but this leads to the question of how we might go about conducting research that can help us to understand this "public sphere", and its role in agri-food transitions. We begin to address this in the next section.

4. Qualitative approaches to examining the 'green public sphere' with regards to Chinese agri-food transitions

Many of the survey-based studies introduced in Section 2.2, for reasons that we detail further below, could have been better informed by qualitative research, particularly around consumers' food choices and attitudes to GM, as well as regulation, environmental attitudes and more, including those uncovered by investigating their attitudes to non-GM and organic foods. We next describe a small, preliminary piece of research that explored such approaches. Our research did not set out to replicate or challenge the generalizable conclusions sought by large-scale quantitative research. Rather, we aimed to begin to uncover some of the cultural and social dynamics around trust in regulation, environmental and health awareness and more, to understand how future research designs could better inform policy-making around food and agriculture in China, particularly around GM foods and their potential commercialization.

4.1 Research methods

The research presented here draws on three focus group discussions and 19 individual interviews, which formed a small part of a much wider project investigating 'Low Carbon Innovation in China: Prospects, Politics and Practice' (Tyfield et al 2015). The focus groups were all conducted in Beijing with the help of a research assistant. Focus group one comprised five female postgraduate students of agricultural policy at a government-linked institution in Beijing; focus group two comprised five male students at the same institution; and focus group three comprised five farmers, from different farms in the Beijing area, all serving urban markets focused on organic and ecological products. Of the 11 one-on-one interviews with consumers, 10 were selected through convenience sampling in Beijing. The final interview was conducted with a social entrepreneur in the food and agriculture field in Beijing, who also helped to organise focus group three. These were undertaken alongside 8 elite interviews with scholars, policy advisors, private sector and NGO representatives that were conducted in English by the authors themselves.

The interviews and focus group discussions, which typically lasted an hour, were semi-structured and followed a set of guiding questions on attitudes towards GM and organic foods (see Table 1). Focus group three contained particular questions that reflected farmers' role as producers, as well as consumers (see Table 2). All apart from the individual interview with the social entrepreneur were conducted in Chinese; a research assistant acted as interpreter, where necessary, and Chinese transcriptions were translated into English by the lead author.

The analysis, which aimed to explain the empirical work through the themes outlined in Section 2.2, also drew on a further 10 one-on-one interviews with six scientists and experts, three NGO

activists and one private sector representative, all focused on food and agriculture issues in China (reference removed for anonymization), as well as short-term participant observation at NGO and farmer-organised meetings in Beijing and Guangxi.

[Table 1 and Table 2 insert here]

4.2 Findings and resonances with concepts from European literature

Our findings resonated with various themes that have emerged in the European literature (described in 2.2 above). They suggest the binary classification of consumers as pro- or anti-biotech, or as regarding GM foods as either safe or unsafe, oversimplifies their perceptions. Consumers in our study tended to understand GM foods in terms of their complex interactions with multiple factors, including: the environmental and health effects of conventional, organic and GM agriculture; their trust or distrust of the efficacy of food and agricultural regulation, as it relates to organic and conventional agriculture, as well as GMOs; and a sense of uncertainty about the long-term health effects of GM foods, even where they may present short-term environmental or social benefits. We also found that higher levels of education did not necessary indicate trust in the regulation and safety of GMOs, and found a low level of awareness among ordinary consumers around the status of commercialisation of GM crops in China, even as many had sophisticated opinions around the interactions of social, environmental and other factors around food and agriculture.

Regulation and trust

Many respondents' concerns centred around distrust of the regulatory system of both GM and organic foods. An organic farmer said "I don't trust regulation broadly. The organic certificate doesn't mean anything. People can buy certification. It's been corrupted by money." This distrust was also common among consumers. A 55-year old retired man with high school education said "government regulation of GM isn't good", and added that "consumers should have a right to know." Asked about the regulation of organic foods, he said: "government regulation is poor. I have a sceptical attitude towards foods labelled as organic in the supermarket. Now when you buy organic there is no way to trace back to the source." A 64-year-old retired farmer with high school education, said "I think the government completely doesn't regulate" GM foods. He also thought "you don't know if you are really getting organic cauliflower or free range eggs." A retired forester, aged 58, told us: "China's regulation isn't strong. Locally, there's a 'no oversight' attitude" and there are "rampant fakes on the market." As a social entrepreneur put it, people do not trust the source of their food, "because in general people don't trust the government, or government-appointed experts."

Some respondents had believed GM foods were unhealthy or unsafe. A retired, 64-year-old male forester from Inner Mongolia, with a high-school education, told us: "I think GM foods are harmful to people's health and China should definitely completely ban GM planting." In a focus group of female agriculture postgraduate students, one respondent told us "I'm unsure about [GM foods'] safety and don't buy." Another said, "I'm unsure about my children eating [GM foods] and do not to buy them."

However, many had complex concerns about health, environment and the impacts of organic and conventionally grown crops, including on farmers and producers. For example, the 64-year-old man who saw GM foods as harmful to health regarded the crops as having a positive impact on the environment, "because GM can be insect resistant and reduce pesticides, which is good for the environment." Many consumers suggested GM crops would have higher yields and lower inputs, increasing benefits for farmers. Others noted this could increase health outcomes for farmers given less pesticide use decreased the risks of poisoning. A 51-year-old female retired farmer with primary education said she thought GM foods were bad for human health, but added that they were "good for the environment" because of reduced chemical inputs. This meant, she said, a "positive impact on farmers" and "less health dangers from chemicals. My family has twice been poisoned by agricultural chemicals."

Farmers also said their consumers' desires had changed: a shift towards eating organic food would take place in China, said one, first because of food safety, "then, lifestyle: customers want a closer relationship to the soil and the land. They want a more relaxed way of living with contact with nature and farms. This is the trend in consumption, where before it was about going to the supermarket." Another said that consumers increasingly associated infertility with environmental risks and would "pay lots of money for fruit vinegar", seeing it as a potential cure. A Beijing-based social entrepreneur also said of the demand for ecological, non-GM food, "At first people come for safe food… but [increasingly] they also understand there are values. They support us and know the price is fair and they know the producers quite well and like the feeling of connection."

Education and knowledge

Our small sample indicated – much as Huang and Peng (2015) also found on a larger scale – that educational level did not necessarily correspond with trust or acceptance of GM foods; some respondents with higher educational level expressed distrust about uncertainties and regulatory failures around GM foods. A female postgraduate student of agricultural policy said, for example, that the issue was complex and uncertain: in the case of transgenic Bt cotton, she said, bollworm was reduced, but new pests may have been introduced. She, and many others with higher educational levels, expressed concerns about the efficacy of regulation.

Some respondents with a relatively lower educational level expressed a high degree of trust in government regulation: one 50-year-old woman working as a volunteer in elder care, for example, said she trusted government regulation and that GM foods have "a positive impact on society, as they are the result of scientific and technological progress." Her knowledge about GM was relatively limited; she shared the misperception that consumers could already (legally) buy many GM products. For example, a 53-year old female subway station security volunteer, with a high school education, told us: "GM foods have a beautiful colour, they look and taste good. I occasionally buy, but rarely eat because they are unhealthy."

It was also clear that public debates around the topic were common and reflective of changes in the media sphere, not only in terms of diverse points of view that are represented, but also technological changes. The 64-year-old retired farmer with a high-school education told us he knew about GM foods "from seeing them on television, and often hear people talking about GM

foods". A 58-year-old retired forester told us "I know GM foods. I saw them in the newspapers, television and WeChat [mobile social messaging app]. Last year the TV said to support GM and it was good for your health, this year the TV and WeChat says GM isn't good for health. I myself am not certain."

The role of "alternative media" (in the words of Yang and Calhoun 2007) further indicates that this – beyond the mainstream media that forms the focus of most work (Du and Rachul 2012; Liu and Cong (2014) – deserves greater attention. This is particularly the case in China, where social media represents a comparatively uncontrolled space for public debate. Whilst we do not report work of this sort in this paper, some preliminary research investigating web searches relating to GM in China is reported in Ely et al (2014).

Despite the different governance context in China (in comparison to the European context), the findings above resonate with various ideas from the European literature and lead us to the conclusion that more in-depth work of this kind could usefully contribute to a fuller appreciation of the country's agri-food transitions. We next consider the implications for this focus on the "green public sphere" in future research on agri-food transitions in China, highlighting key questions that we believe deserve further investigation.

5. Conclusions

Studies of public perceptions of new technologies have been relatively absent from research into contemporary agri-food transitions, and no more so than in the Chinese context. Our study

highlights a number of areas, illustrated in Section 4, that have previously been overlooked in scholarship and policy debates. First, as suggested by some (but not all) previous studies (e.g. Huang and Peng 2015) educational level and/or levels of technical knowledge regarding GM technology and related policies should not be assumed to relate to acceptance or support for the technology. Instead, perceptions towards GM food relate to a much broader range of factors than knowledge about technical details (e.g. Huang *et al* 2006; Lü 2006), favourable or unfavourable media coverage (e.g. Du and Rachul 2012; Liu and Cong 2014), demographic details or geographical location (Li *et al* 2002; Fei *et al* 2015). These factors seem to include trust in regulations and their implementation, concern around health and environmental problems in China and, relatedly, suspicions around novel food technologies within China's changing agri-food system. As such, we find that the notion of the 'green public sphere' is useful in understanding these dynamics.

Yan (2012) has noted how the great number of risks around food safety in China have contributed to a "rapid decline in social trust" and Klein (2013) found that in Kunming, "concerns about the food supply were feeding into wider ambivalences about modernization". Our findings seem to reflect this and suggest a relationship between widely-recognised regulatory failings in food safety with attitudes towards GM foods, potentially amplified by discussions in the public sphere. It appears that levels of trust in the Chinese food safety system are low, and are likely linked to these failings as much as targeted efforts by campaigning groups or the media, as suggested in other studies (e.g. Huang and Peng 2015; Fei *et al* 2015).

The commercialization of GM crops interacts in complex and dynamic ways with China's changing public sphere. Investigating and public perspectives within the context of this public sphere illuminates the ways in which people consider and frame the risks and uncertainties around GM commercialization – and the ways in which these considerations interact with factors like technical knowledge, access to information and trust in government regulation.

Research into public perceptions to food and agriculture in China – by adopting the "deficit model" approach illustrated above – have assumed a less complex public sphere, limiting the value of their conclusions and the effectiveness of their proposed policy approaches. The early findings of this study suggest that, in fact, publicising the government's efforts to respond to the underlying problem of low public trust (as a result of regulatory failures around food safety, for example, in the case of melamine-tainted milk – cf. Xiu and Klein 2010) might be more effective than popularising scientific knowledge about GM crops. The revised *Food Safety Law*, for example, has been described as the most stringent in the country's history (Keller and Heckman 2015), and – if effective implementation is achieved – may serve to build further trust, alongside increasing transparency and accountability.

In understanding the role of public perceptions and the green public sphere in agri-food transitions, we argue that more research (using mixed, qualitative and quantitative methods) is required to go beyond the concepts deployed by European scholars and deliver frameworks that allow a richer appreciation of phenomena described above in the Chinese context. Rather than applying arguments based on Western notions of participatory democracy (which are implicit in much of the transitions literature), we argue that the Chinese case requires an analysis that is

sensitive to the country's very different governance context. Concepts such as "fragmented authoritarianism" (Lieberthal and Oksenberg 1988) and "consultative authoritarianism" (Teets 2014) may offer resources for such an analysis. The fact that China's society and governance context continues to change (and thus the possible obsolescence of these concepts) also needs to be borne in mind.

We believe the following questions and areas of research on agri-food transitions may deserve more attention in future and could prove productive in the Chinese context. First, while earlier studies have studied food safety incidents, such as appropriate government responses to melamine-tainted milk (Pei *et al* 2011), studies on the resulting (or associated) changes in consumer perceptions have been lacking. The extent to which these changes may also influence perceptions towards GM technologies is an important question. Relatedly, it is unclear whether – and in which ways – scandals such as illegal production of Bt63 rice and maize influence public perceptions of the current and future use of GM technologies. The importance of the public sphere in such dynamics, and in determining the legitimacy of potential agri-food transitions involving GM technologies, deserves attention.

Second, the above research (taken with the existing literature) illustrates that knowledge is relevant in determining perceptions, but that it does not necessarily relate positively with acceptance. Rather than taking this as another critique of the deficit model (as it has been conceptualised in European scholarship), further exploration is worthwhile in the Chinese context by exploring the ways in which a changing society deals with questions around knowledge, trust, acceptance and more. While trust in regulatory institutions has been studied at

length in Europe, it is important to recognise how differently it may be understood in the Chinese political context, where theoretical approaches common in the European literature may need to be adjusted to meaningfully analyse future empirical findings. Interestingly, a recent study of nuclear energy (Dai 2015) – another controversial technology in China – suggests that acceptance of government decisions reflects citizens' ability to take part in them, and to access reliable, trustworthy information within a well-understand institutional context. Studies that investigate similar relationships in the GM food area will be useful to inform appropriate decisions around agri-food transitions in China over the coming years.

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